

Probing modifications of the electronic structure of surfaces induced by slow, highly charged ions

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Slow ($v < 2 \times 10^6$ m/s), highly charged ions (SHCI), such as Xe^{44+} and Au^{69+} deposit 50 to over one hundred keV of potential energy into nanometer scale surface areas within a few femtoseconds when they impinge on solids. Surfaces respond to this intense ($\sim 10^{13}$ to 10^{14} W/cm²), ultrafast electronic excitation by the emission of electrons, by sputtering and with topographical changes of the surface structure. We recently reported on light emission from silicon surfaces that were exposed to low doses ($\sim 10^{10}$ to 10^{11} cm⁻²) of SHCI [1]. Here, light emission was probed in *ex situ* photoluminescence experiments. In our presentation, we will report on results from studies at the EBIT facility at LBNL [2] where we probe the modification of the electronic properties of different surfaces by the impact of SHCI, and discuss models of the underlying mechanisms. We use *ex situ* photoluminescence and also began *in situ* spectroscopy of light emission in the range from 250 to 1200 nm during the impact of SHCIs. Materials studied are silicon with varying dopant levels, SiO₂, and scintillator powders. Measurements of electron emission yields complement the light emission studies.

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References

- [1] A. V. Hamza, M. W. Newman, P. A. Thielen, H. W. Lee, T. Schenkel, J. W. McDonald, D. H. Schneider, Appl. Phys. Lett. 81, 2973 (2001)
- [2] T. Schenkel, A. Persaud, A. Kraemer, J. W. McDonald, J. P. Holder, A. V. Hamza, and D. H. Schneider, Rev. Sci. Instr. 73, 663 (2002)